

by the Chicago office and the Central Office at Washington to all States, except a portion of Montana, where its appearance could not be foreseen. Additional warnings were sent to all districts threatened with the advice that the storm and cold wave would be unusually severe. Press reports indicate that large numbers of cattle were saved in the Western States by the warnings, and that other interests were greatly benefited. The gale which attended the severe storm which preceded the advance of the cold wave was very high on the Lakes, and all vesselmen remained in port, except when it was possible for stanch craft to move along the lee shores.—*H. J. Cox, Fore-cast Official.*

SAN FRANCISCO FORECAST DISTRICT.

No marked or destructive weather changes or conditions were reported in the Pacific coast forecasting districts.

GALVESTON FORECAST DISTRICT.

Mr. I. M. Cline, local forecast official and section director, Galveston, Tex., has submitted the following report in connection with special temperature warnings issued November 21, 1898:

The following warning was issued at 4 p. m.: "Temperature will probably fall to 30° within 100 miles of Galveston and to 42° at Galveston Tuesday."

All sugar planters and truck growers to the coast line were advised over the telegraph and long-distance telephone to protect their crops and they acted without delay. The minimum temperature on Tuesday, the 22d, fell to and below freezing throughout the interior of the State and reached 34.5° at Galveston. Many acknowledgments of the value of the warnings were received, and cane and vegetables to the value of many thousands of dollars were reported saved.

AREAS OF HIGH AND LOW PRESSURE.

During November the paths of nine highs and of fourteen lows were sufficiently well defined to be traced on Charts I and II. On these charts a circle is placed at the position of each center of high or low pressure at 8 a. m. and 8 p. m., eastern time, with the date on the outside of the circle, and the reading of the barometer on the inside. The accompanying table exhibits the principal facts regarding the first and last appearance of the highs and lows, their duration, and apparent velocity.

Highs.—There seemed to be a rather permanent high pressure area on the middle Pacific coast, and some of the highs appeared to originate or separate from this permanent condition. Nos. VII and VIII were first noted to the north of Montana. The general tendency of the highs was along a lower parallel than in October. No. I disappeared in the middle Rocky Mountain region. Nos. III, V, and VII were last seen over Newfoundland, and the rest disappeared off the middle Atlantic coast. The temperature conditions accompanying these highs were quite moderate. On the 8th, as No. IV passed across the middle Rocky Mountain region, there was a fall of 30° in twenty-four hours at Denver in the morning, and of 34° in the evening at Pueblo. The severest cold wave of the month accompanied high area No. VII, and in this area the highest absolute barometer readings of the month were noted. On the evening of the 20th Denver experienced a fall in temperature of 50° in twenty-four hours, and to 12°. On the morning of 21st Denver reported a fall of 54°, and to 4°. On evening of 21st the cold wave had moved rapidly eastward, Springfield, Mo., experiencing a fall of 52°, and to 12°. The next morning the same station reported a fall of 44°, and to 12°. On evening of 22d Chicago reported a fall of 42°, and to 14°, and Cincinnati had a fall of 42°, and to 22°. On morning of 23d Columbus and Cleve-

land reported a fall of 36°, and to 20° and 18° respectively.

Lows.—The month was very prolific in low areas, no less than fourteen having been charted. Nine of these began to the north of Montana; one, No. XI, in the Red River Valley; Nos. IV and VI in Arizona; and X and XIV on the south Atlantic coast. The general track of these lows was along the north border of the United States, and ten of them were last noted off Nova Scotia or over Newfoundland. No. XIII was last seen in Ontario. Nos. V, XI, and XII in the Red River Valley, and VI in the central Gulf.

The highest winds of the month were reported as follows: As storm No. II approached Lake Superior, afternoon of 4th, a south wind of 60 miles an hour occurred at Chicago. As the same storm passed the lower Lake region it caused a west wind of 68 miles at Buffalo. On the afternoon of 11th, as IV passed to the north Atlantic coast, it caused a northwest gale of 56 miles at New York City. On the afternoon of 21st, as No. IX approached Lake Michigan, Duluth experienced a northwest wind of 52 miles, and Grand Haven the same velocity from the southeast. On the evening of 26th, as storm No. XI passed up the middle Atlantic coast, Block Island reported a northeast wind of 60 miles and accompanying the same storm the next morning Hatteras and New York City reported a northwest wind of 56 miles, Sandy Hook a north-east wind of 60 miles, Boston a north wind of 56 miles, and Eastport a northeast wind of 56 miles.—*H. A. Hazen, Professor.*

Movements of centers of areas of high and low pressure.

| Number. | First observed. | | | Last observed. | | | Path. | | Average velocities. | |
|------------------------|-----------------|---------|----------|----------------|---------|----------|---------|-----------|---------------------|---------|
| | Date. | Lat. N. | Long. W. | Date. | Lat. N. | Long. W. | Length. | Duration. | Daily. | Hourly. |
| High areas. | | | | | | | | | | |
| I..... | *31, p. m. | 43 | 127 | 2, p. m. | 39 | 106 | 1,210 | 2.0 | 605 | 25.2 |
| II..... | 3, p. m. | 37 | 124 | 8, p. m. | 37 | 75 | 8,540 | 5.0 | 708 | 29.5 |
| III..... | 6, p. m. | 41 | 126 | 10, p. m. | 48 | 55 | 3,730 | 4.0 | 930 | 38.7 |
| IV..... | 7, p. m. | 43 | 123 | 14, a. m. | 41 | 69 | 3,060 | 6.5 | 471 | 19.6 |
| V..... | 11, p. m. | 43 | 120 | 18, a. m. | 47 | 56 | 4,260 | 6.5 | 655 | 27.3 |
| VI..... | 15, p. m. | 42 | 121 | 21, p. m. | 36 | 73 | 3,070 | 6.0 | 512 | 21.3 |
| VII..... | 18, p. m. | 54 | 117 | 25, p. m. | 47 | 61 | 3,480 | 8.0 | 435 | 18.1 |
| VIII..... | 23, p. m. | 52 | 108 | 29, a. m. | 38 | 73 | 2,430 | 5.5 | 442 | 18.3 |
| IX..... | 26, p. m. | 42 | 116 | 30, p. m. | 31 | 78 | 3,030 | 4.0 | 757 | 31.6 |
| Total..... | | | | | | | 27,900 | 47.7 | 5,515 | 229.6 |
| Mean of 9 paths..... | | | | | | | 3,089 | | 618 | 25.5 |
| Mean of 47.5 days..... | | | | | | | | | 585 | 24.4 |
| Low areas. | | | | | | | | | | |
| I..... | *29, p. m. | 47 | 125 | 2, p. m. | 48 | 66 | 3,030 | 4.0 | 757 | 31.6 |
| II..... | 1, p. m. | 55 | 118 | 7, p. m. | 47 | 54 | 3,480 | 6.0 | 580 | 24.2 |
| III..... | 6, a. m. | 52 | 120 | 8, p. m. | 49 | 69 | 2,580 | 2.5 | 1,032 | 43.0 |
| IV..... | 7, a. m. | 32 | 114 | 11, p. m. | 48 | 59 | 3,480 | 4.5 | 580 | 24.2 |
| V..... | 9, p. m. | 55 | 114 | 11, a. m. | 52 | 96 | 780 | 1.5 | 520 | 21.7 |
| VI..... | 10, p. m. | 34 | 114 | 13, a. m. | 29 | 93 | 1,290 | 2.5 | 516 | 21.5 |
| VII..... | 11, p. m. | 53 | 118 | 14, p. m. | 49 | 55 | 2,670 | 3.0 | 890 | 37.1 |
| VIII..... | 16, p. m. | 53 | 118 | 20, p. m. | 47 | 56 | 3,270 | 4.0 | 817 | 34.1 |
| IX..... | 18, a. m. | 51 | 123 | 23, p. m. | 42 | 67 | 3,050 | 5.5 | 555 | 23.1 |
| X..... | 23, a. m. | 34 | 76 | 25, p. m. | 46 | 58 | 1,350 | 2.5 | 540 | 22.5 |
| XI..... | 24, p. m. | 49 | 99 | 29, a. m. | 44 | 58 | 2,880 | 4.5 | 640 | 26.7 |
| XII..... | 25, p. m. | 52 | 116 | 27, a. m. | 52 | 97 | 810 | 1.5 | 540 | 22.5 |
| XIII..... | 27, a. m. | 52 | 123 | 30, a. m. | 47 | 81 | 1,830 | 3.0 | 610 | 25.4 |
| XIV..... | 29, a. m. | 31 | 80 | *1, p. m. | 44 | 60 | 1,890 | 2.5 | 756 | 31.5 |
| Total..... | | | | | | | 32,390 | 47.5 | 9,333 | 389.1 |
| Mean of 14 paths..... | | | | | | | 2,314 | | 667 | 27.8 |
| Mean of 47.5 days..... | | | | | | | | | 682 | 28.4 |

* October.

† December.

RIVERS AND FLOODS.

The annual rise appears to have set in during the latter half of the month, except in the Missouri and upper Mississippi rivers, where steady rises are not the rule during the winter season. The Ohio and its tributaries were the first to rise, the crest of the highest water reaching Parkersburg on the 14th, Cincinnati on the 17th, and Cairo on the 20th, and thence extending down the Mississippi. The highest waters